Geologic Hazards in Washington

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Geological Hazards

- Earthquakes – research earthquake shaking and ground failure; identify active faults, socio-economic loss, potential damage to infrastructure and potential loss of life
- Tsunamis – inundation mapping, evacuation route planning and collateral damage evaluations
- Landslides – database management, mapping, forecast and response
- Volcanic hazards – estimate socio-economic loss and plan response

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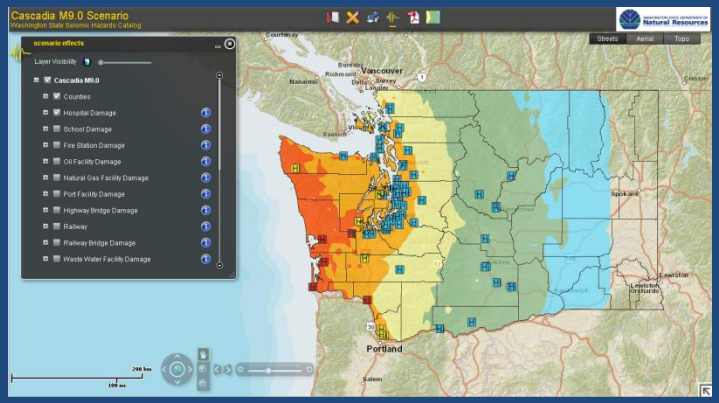
Earthquakes

- Liquefaction mapping
- Seismic Scenario Catalog
- Active Fault maps
- Identify escape routes and vulnerable roads

"We all learn geology the morning after the earthquake."
Ralph Waldo Emerson



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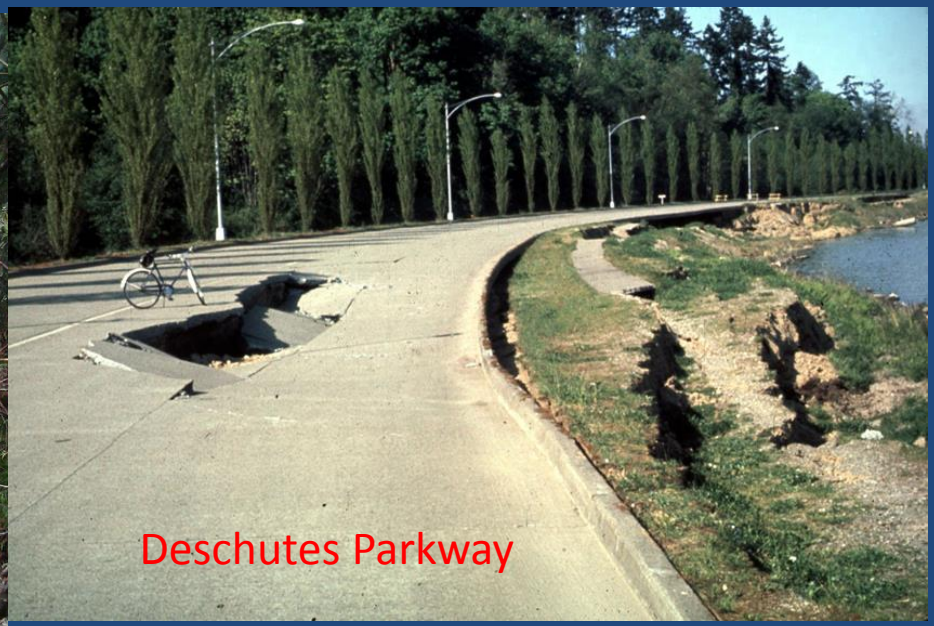
Earthquake-Induced Landslides



Tsunamis

We have prepared tsunami inundation and evacuation maps for many coastal communities. As funding allows these maps are being evaluated by us for feasibility during a Cascadia type earthquake and tsunami. Identifying risks to these roads is key to ensuring their availability when evacuations are needed.

Oregon has prepared tsunami inundation maps and models 3 times for their entire coast . Washington has done about 1/3 of our coast.

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SUNDA TRENCH

Plate Tectonic Setting
Subduction zone: India plate subducting beneath Burma plate
Rate:~5 cm/year
Dip of interface: ~10°

2004 Earthquake
Date: December 26, 2004
Magnitude: 9.0
Rupture length: 1200 km
Rupture width: 100 km

BURMA PLATE

INDIA PLATE

Most Recent Previous Great Earthquake
Date: November 24, 1833
Magnitude: 8.8–9.2
Recurrence interval: 230 years

1000 km

AUSTRALIA PLATE

Tsunami Characteristics
(extremely preliminary estimates from media accounts)
Peak tsunami height in the near-source area: ~80 ft in Indonesia
Peak tsunami height in Somalia (8 hours travel time and 3300 mi away): ~10 ft
Affected the entire Indian Ocean

CASCADIA SUBDUCTION ZONE

Plate Tectonic Setting
Subduction zone: Juan de Fuca and Gorda plate subducting beneath North American plate
Rate:~3 cm/year
Dip of interface: ~12°

PACIFIC PLATE

JUAN DE FUCA PLATE

NORTH AMERICAN PLATE

Most Recent Great Earthquake
Date: January 26, 1700
Magnitude: ~9.0
Rupture length: ~1000 km
Rupture width:~80 km
Recurrence interval: 500 years

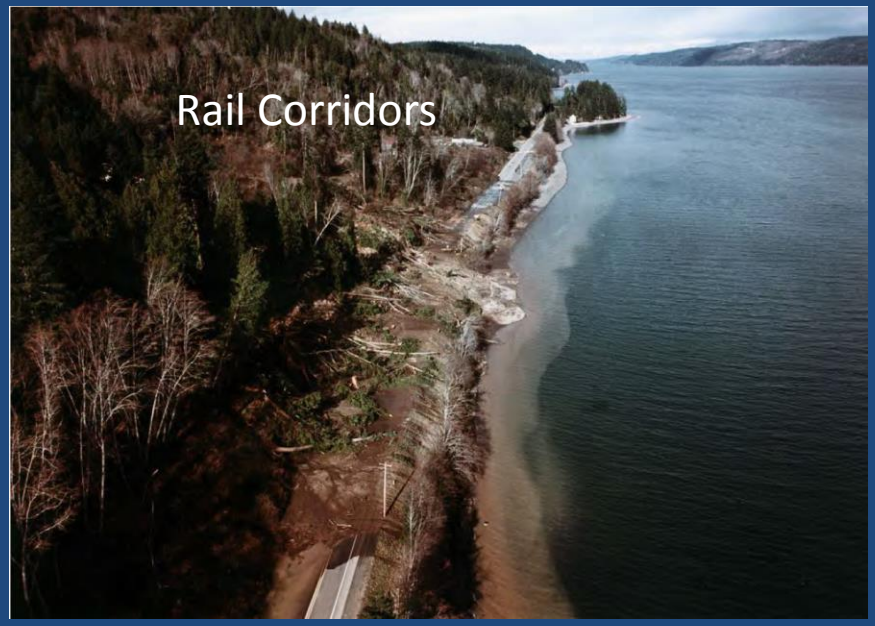
1000 km

PACIFIC PLATE

Tsunami Characteristics
(rough estimate from Native American oral history and written records in Japan)
Peak tsunami height in the near-source area: ~60 ft at mouth of Redwood Creek, Northern California (from Yurok stories)
Peak tsunami height in Japan (9 hours travel time and 3900 miles away): ~15 ft

Landslides and Transportation

- State wide data base of ~50,000 mapped landslides
- Response to large landslides and storm events
- Shallow Landslide forecasting website



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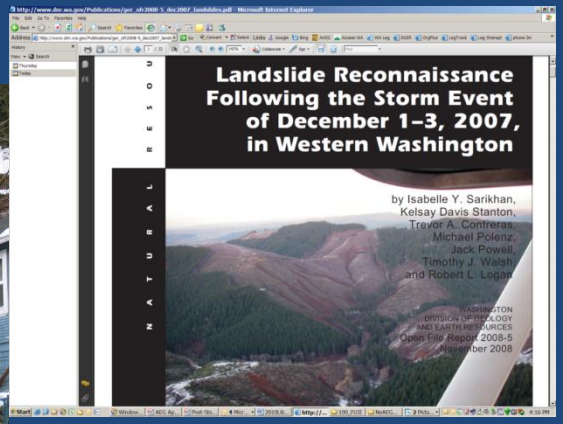
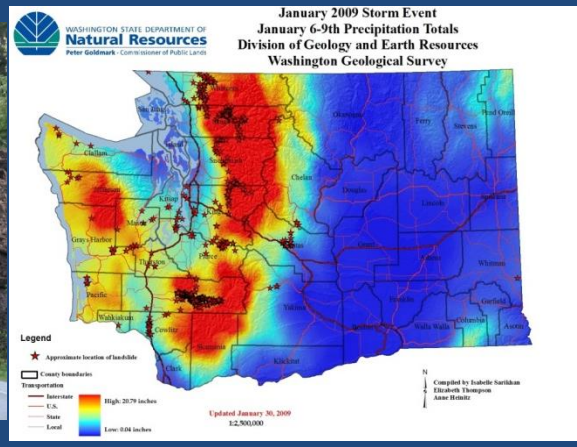
Response, Data Collection, and Reporting

Some Examples

- 1997 – 136 homes destroyed in Cowlitz County
- 2007 storm event ~1600 Landslides
- 2009 event ~1500 landslides
- 2013 Ledgewood Landslide on Whidbey Island
- 2014 SR530 Landslide
- 2009 SR410 Nile landslide
- 2015 Hoquiam





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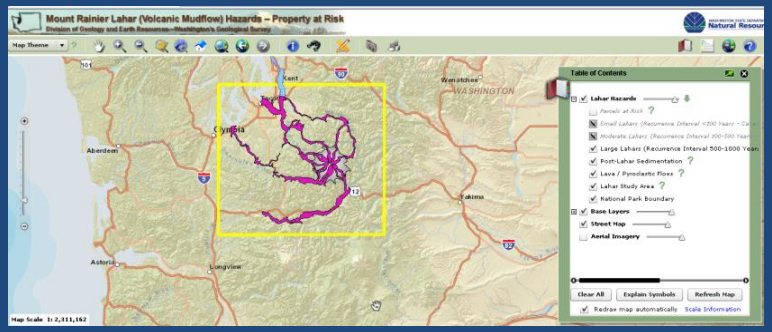
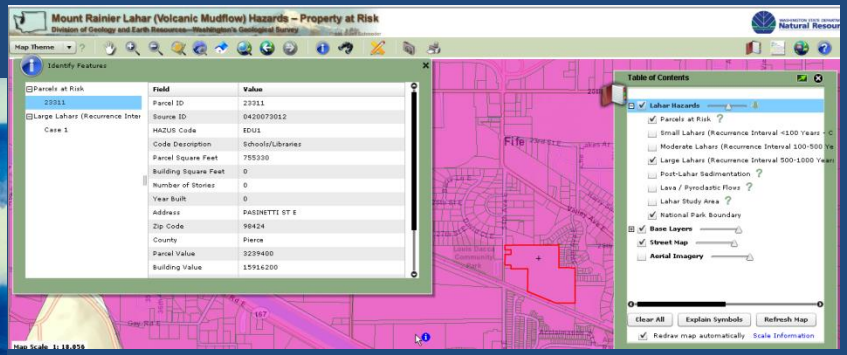
Mount Rainier – the most dangerous volcano in North America

$40 billion in losses for all six drainages

$13 billion for Puyallup





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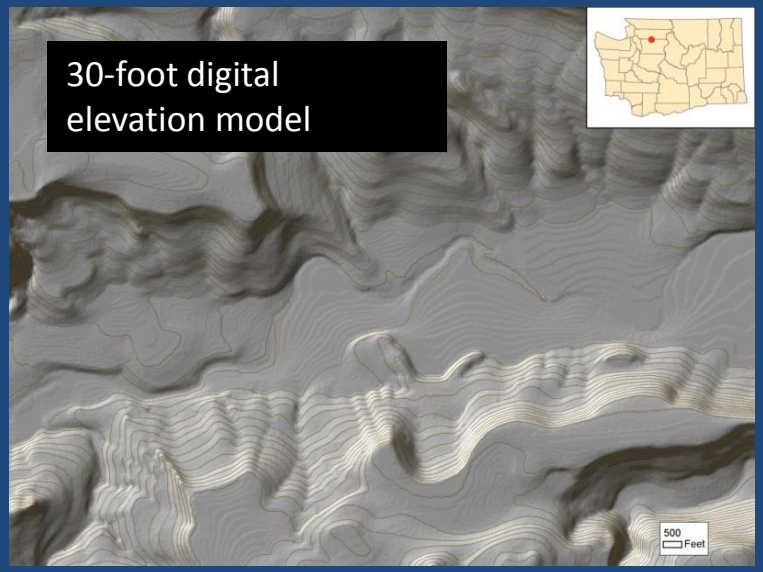
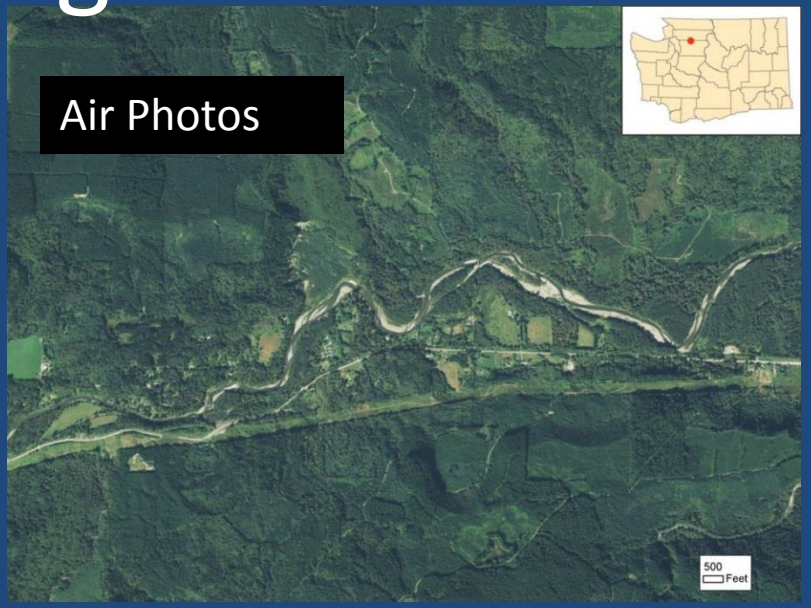
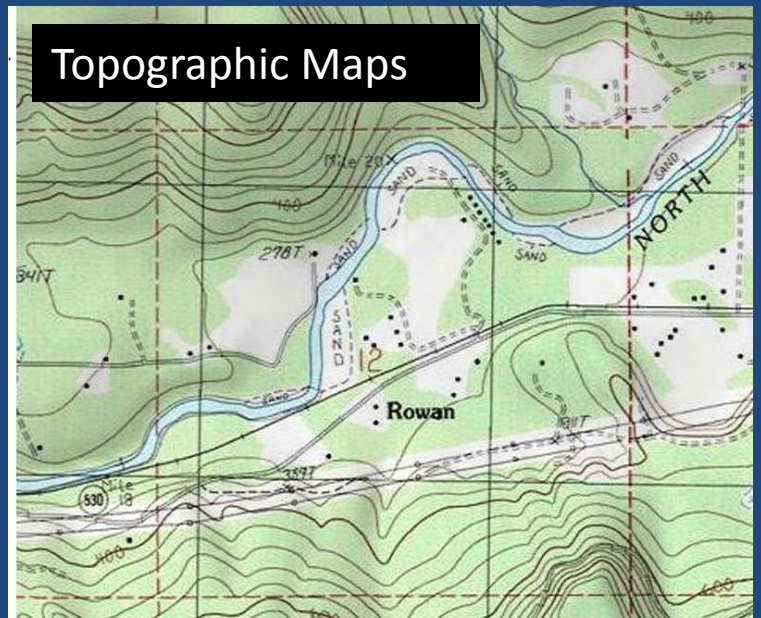
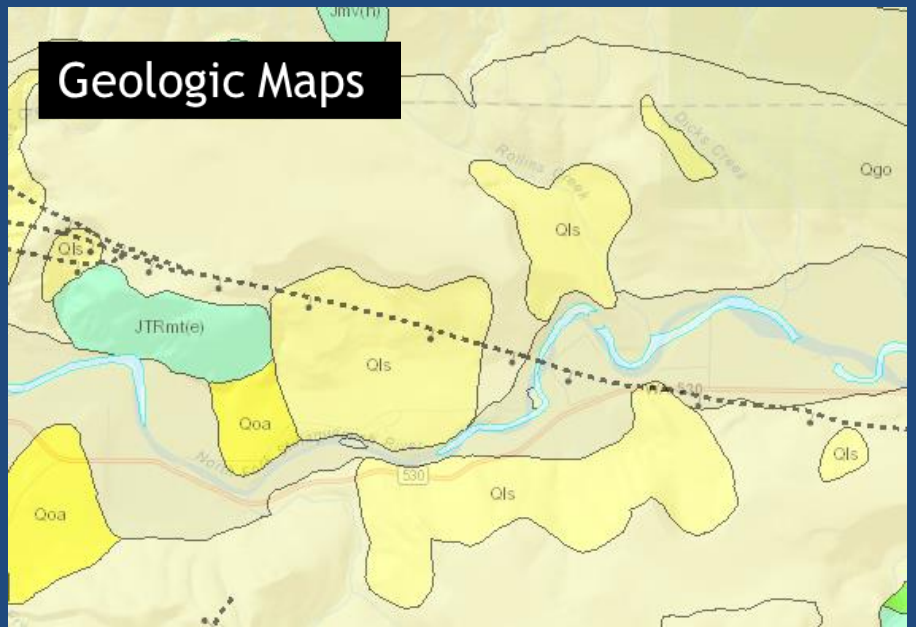
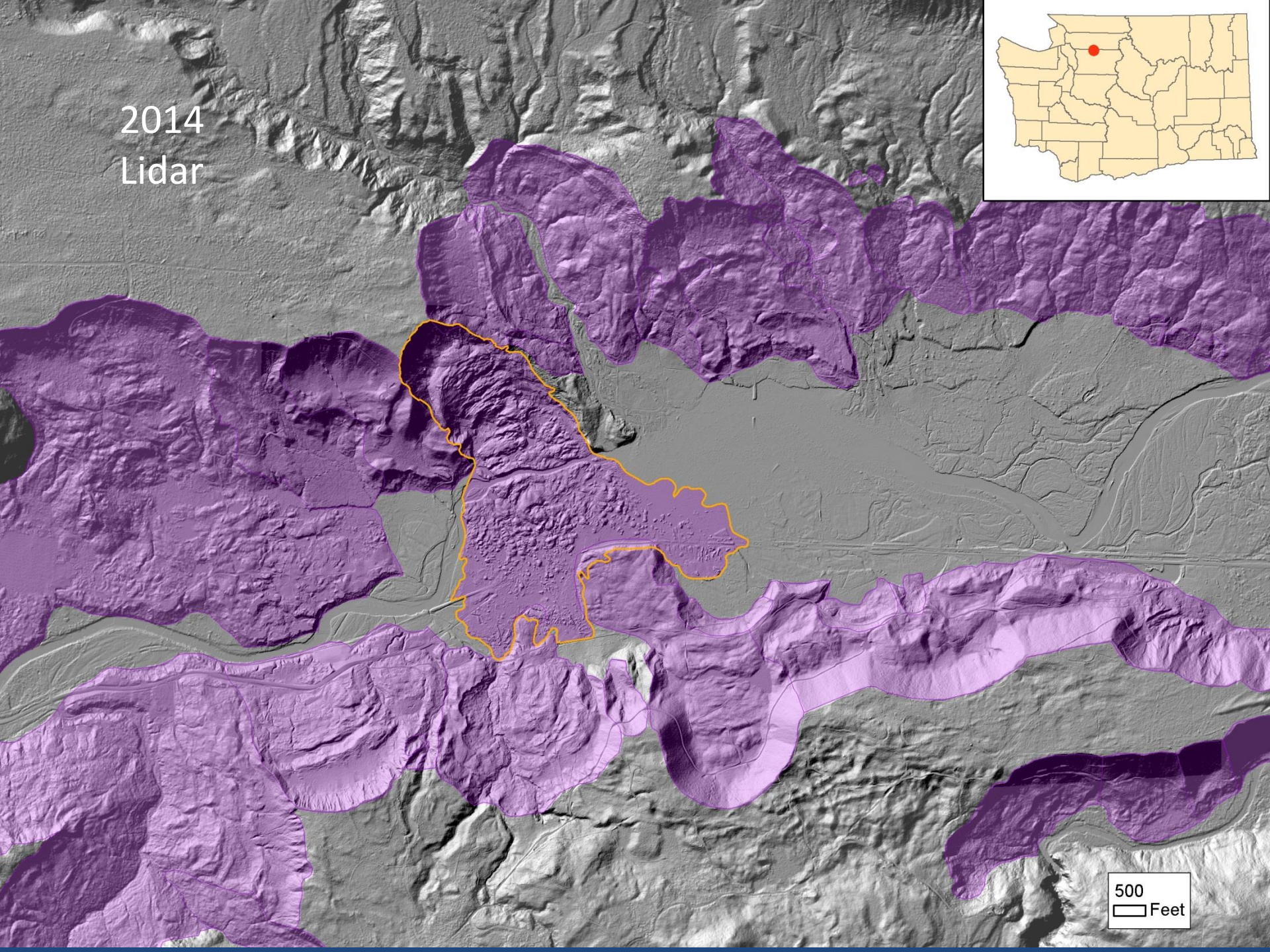
Landslide mapping without Lidar










2014
Lidar
500
Feet

Where We Rank

- Second most at-risk state for earthquakes
- Most dangerous volcano in North America
- Active subduction zone off the coast with potential to generate a tsunami that can reach our coast in 30 minutes
- Washington has had the largest landslide, the most deadly landslide, and the second most homes destroyed by a landslide in North America
- 13th in population and 14th in GDP
- Bottom 1/3 or 34th in funding for your State Geological Survey

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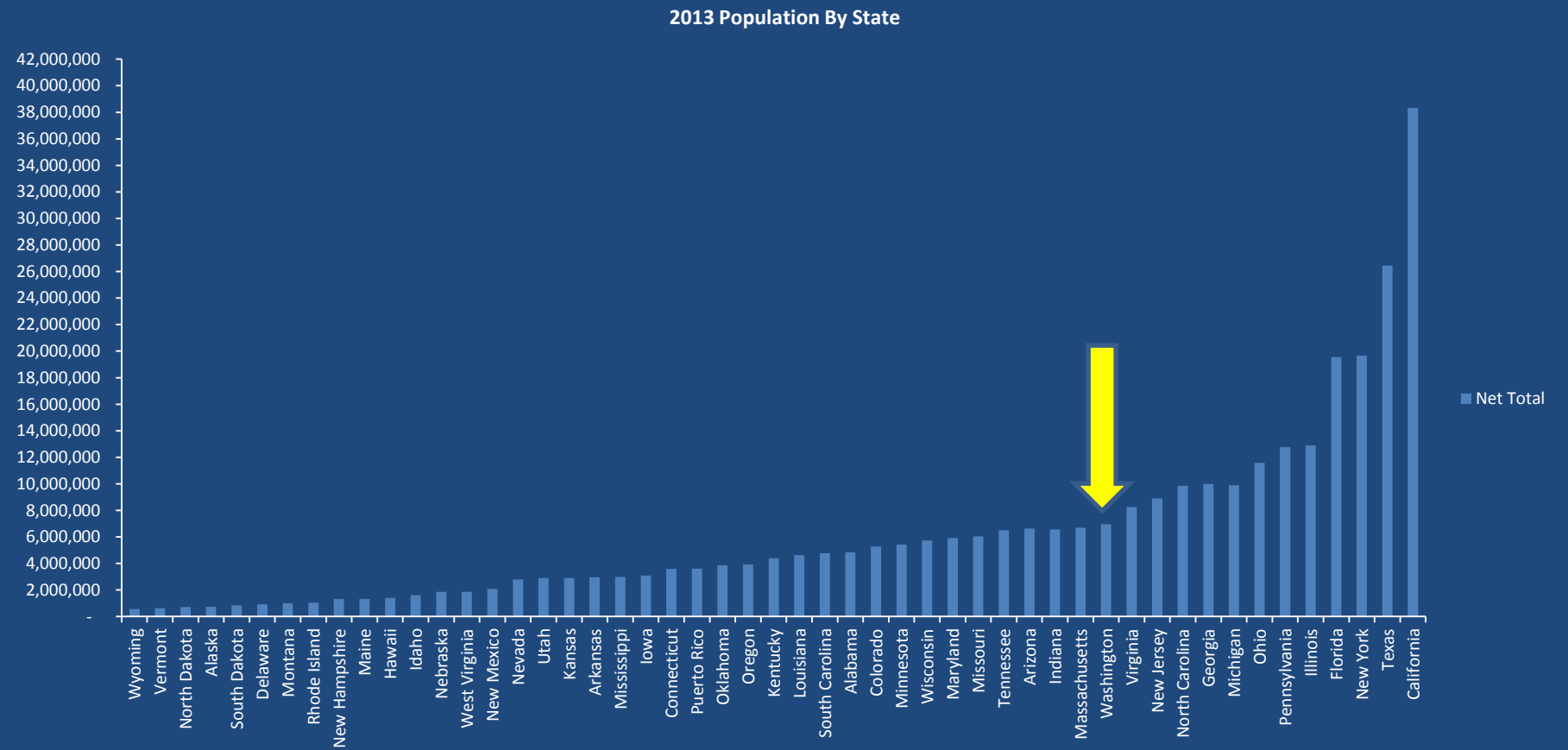
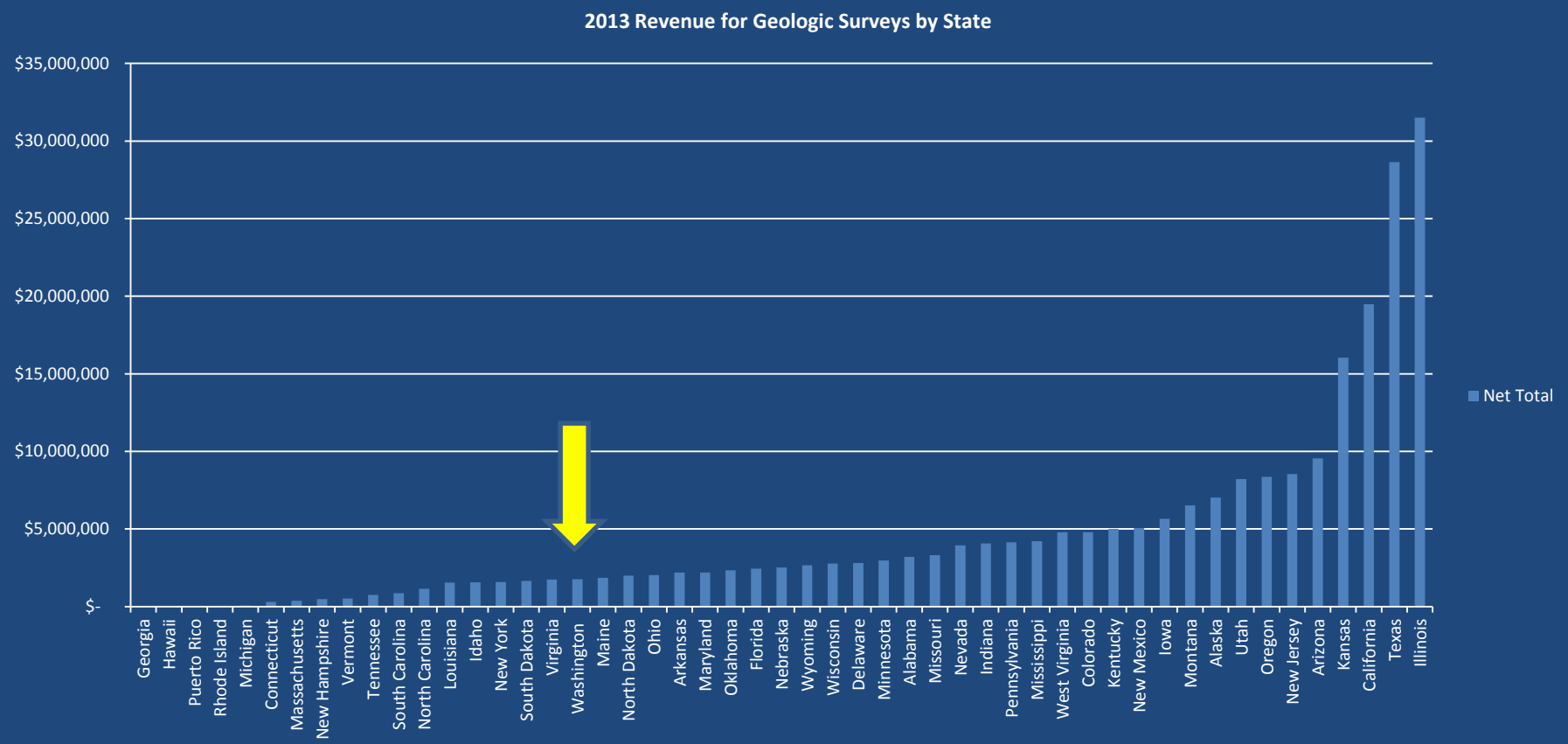

2013 Population By State
42,000,000
40,000,000
38,000,000
36,000,000
34,000,000
32,000,000
30,000,000
28,000,000
26,000,000
24,000,000
22,000,000
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
-
Wyoming
Vermont
North Dakota
Alaska
South Dakota
Delaware
Montana
Rhode Island
New Hampshire
Maine
Hawaii
Idaho
Nebraska
West Virginia
New Mexico
Nevada
Utah
Kansas
Arkansas
Mississippi
Iowa
Connecticut
Puerto Rico
Oklahoma
Oregon
Kentucky
Louisiana
South Carolina
Alabama
Colorado
Minnesota
Wisconsin
Maryland
Missouri
Tennessee
Arizona
Indiana
Massachusetts
Washington
Virginia
New Jersey
North Carolina
Georgia
Michigan
Ohio
Pennsylvania
Illinois
Florida
New York
Texas
California
Net Total


2013 Revenue for Geologic Surveys by State
$35,000,000
$30,000,000
$25,000,000
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$-
Georgia
Hawaii
Puerto Rico
Rhode Island
Michigan
Connecticut
Massachusetts
New Hampshire
Vermont
Tennessee
South Carolina
North Carolina
Louisiana
Idaho
New York
South Dakota
Virginia
Washington
Maine
North Dakota
Ohio
Arkansas
Maryland
Oklahoma
Florida
Nebraska
Wyoming
Wisconsin
Delaware
Minnesota
Alabama
Missouri
Nevada
Indiana
Pennsylvania
Mississippi
West Virginia
Colorado
Kentucky
New Mexico
Iowa
Montana
Alaska
Utah
Oregon
New Jersey
Arizona
Kansas
California
Texas
Illinois
Net Total

A Recognized Need

Money to map slide hazards will help balance economic, safety interests – Oct. 8, 2014

Legislature cannot overlook public safety – Dec. 7, 2014

Potentially lifesaving national landslide maps are 30 years out of date – April 3, 2014

"(Hazard maps can)… make important information available to policy makers, emergency managers and the public to assist them in carrying out their duties and making their personal decisions."

- John Lovick, Snohomish County Executive
and Dave Somers, Snohomish County Council Chair

"The use of LiDAR to identify these geologic hazards before disaster strikes simply makes sense."

- Major General Bret D. Daugherty,
Adjutant General, State of Washington Military Department

"The benefit-cost analyses show a tremendous return on investment for every dollar spent on LiDAR."

- Kevin T. Gallagher, Associate Director for Core Science Systems
And David Applegate, Associate Director for Natural Hazards, USGS

DNR Decision Package

- A $6,584,000 investment in public safety
- Funds 14 positions to map geologic hazards, model tsunami inundation hazards, collect subsurface data, and collect and analyze LiDAR data
- Creates a centralized LiDAR database that can be used to inform developers, the public and decision makers responsible for planning responses to geologic hazards
- Includes outreach to inform, educate, and assist those decision makers with detailed, current geologic data and maps to incorporate into land use and disaster management planning.

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